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<b>(21) International Application Number:</b> PCT/EP98/00043 <b>(22) International Filing Date:</b> 7 January 1998 (07.01.98) <b>(30) Priority Data:</b> 97100172.2 8 January 1997 (08.01.97) EP <b>(34) Countries for which the regional or international application was filed:</b> CH et al. <b>(71) Applicant:</b> F. HOFFMANN-LA ROCHE AG [CH/CH]; Grenzacherstrasse 124, CH-4070 Basle (CH). <b>(72) Inventors:</b> BÖS, Michael; Marktgasse 8A, CH-4310 Rheinfelden (CH). STADLER, Heinz; Waldhofstrasse 37, CH-4310 Rheinfelden (CH). WICHMANN, Jürgen; Im Wolfischbühl 32, D-79585 Steinen (DE). <b>(74) Agent:</b> POPPE, Regina; Grenzacherstrasse 124, CH-4070 Basle (CH).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> With international search report.
<b>(54) Title:</b> TRICYCLIC BENZO[e]ISOINDOLES AND BENZO[h]ISOQUINOLINES		
<b>(57) Abstract</b> <p>The present invention is concerned with novel benzo[e]-isoindoles and benzo[h]isoquinolines. Since the compounds in accordance with the invention can bind to serotonin receptors (5HT<sub>2</sub>), they are especially suitable for the treatment or prevention of central nervous disorders such as depressions, bipolar disorders, anxiety states, sleep and sexual disorders, psychoses, schizophrenia, migraine and other conditions associated with cephalic pain or pain of a different kind, personality disorders or obsessive-compulsive disorders, social phobias or panic attacks, mental organic disorders, mental disorders in childhood, aggressivity, age-related memory disorders and behavioural disorders, addiction, obesity, bulimia, etc., nervous system damage caused by trauma, stroke, neurodegenerative diseases, etc.; cardiovascular disorders such as hypertension, thrombosis, stroke, etc; and gastrointestinal disorders such as dysfunction of the gastrointestinal tract motility.</p>		

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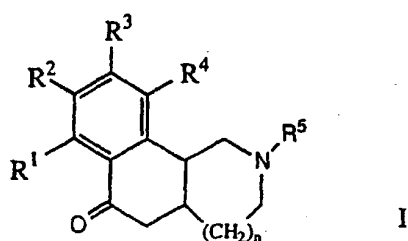
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Tricyclic benzo[e]isoindoles and benzo[h]isoquinolines

The present invention relates to tricyclic compounds. In particular, it relates to benzo[e]isoindoles and benzo[h]-  
 5 isoquinolines of the general formula



wherein

- 10 R<sup>1</sup>-R<sup>4</sup> each independently signify hydrogen, halogen, hydroxy, lower alkyl, lower-alkoxy or phenyl or R<sup>2</sup> and R<sup>3</sup> together represent -O-CH<sub>2</sub>-O-;
- R<sup>5</sup> signifies hydrogen, lower-alkyl or benzyl; and
- n signifies 0 or 1
- 15 as well as pharmaceutically acceptable acid addition salts of the compounds of formula I, with the exception of racemic 2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one.

The compounds of formula I are novel with the exception of rac. 2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-  
 20 6-one (DE 19 26 022). The compounds described in this Offenlegungsschrift have antiphlogistic properties for use against inflammations as well as oedemas following contusions, distortions or fractures.

25 Since the compounds in accordance with the invention can bind to serotonin receptors (5HT<sub>2</sub>), they are especially suitable for the treatment or prevention of central nervous disorders such as depressions, bipolar disorders, anxiety states, sleep and sexual disorders, psychoses, schizophrenia, migraine and other  
 30 conditions associated with cephalic pain or pain of a different kind, personality disorders or obsessive-compulsive disorders,

social phobias or panic attacks,<sup>2</sup> mental organic disorders, mental disorders in childhood, aggressivity, age-related memory disorders and behavioural disorders, addiction, obesity, bulimia etc., nervous system damage caused by trauma, stroke, neuro-degenerative diseases etc.; cardiovascular disorders such as hypertension, thrombosis, stroke etc; and gastrointestinal disorders such as dysfunction of the gastrointestinal tract motility.

10        Objects of the present invention are compounds of formula I and pharmaceutically acceptable acid addition salts, their racemic mixtures and the corresponding enantiomers thereof per se and as pharmaceutically active substances, the manufacture of these compounds and salts, medicaments containing a compound  
15 of formula I or a pharmaceutically acceptable acid addition salt thereof, the production of such medicaments and the use of the compounds of formula I and their pharmaceutically acceptable salts in the control or prevention of illnesses, especially of illnesses and disorders of the aforementioned kind, and,  
20 respectively, for the production of corresponding medicaments. Only the named known compound itself is excluded from the objects of the present invention as previously defined.

The term "lower" denotes residues with a maximum of 7,  
25 preferably up to 4, carbon atoms; "alkyl" denotes straight-chain or branched saturated hydrocarbon residues such as methyl, ethyl, propyl, isopropyl, n-butyl, 2-butyl or t-butyl and "alkoxy" denotes an alkyl group bonded via an oxygen atom, such as methoxy, ethoxy, propoxy, isopropoxy or butoxy.

30

"Halogen" can signify Cl, Br, F or I.

The term "pharmaceutically acceptable acid addition salts" embraces salts with inorganic or organic acids, such as hydro-  
35 chloric acid, hydrobromic acid, nitric acid, sulphuric acid, phosphoric acid, citric acid, formic acid, fumaric acid, maleic acid, acetic acid, succinic acid, tartaric acid, methanesulphonic acid, p-toluenesulphonic acid and the like.

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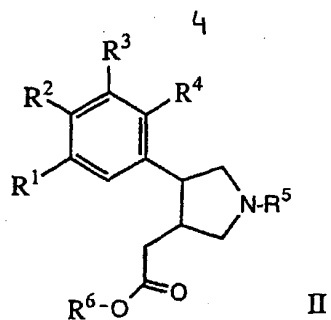
Those compounds in which R<sup>4</sup> signifies hydrogen, R<sup>5</sup> signifies methyl and n signifies 1 are preferred. Thereunder there fall those compounds in which R<sup>1</sup> signifies hydrogen, hydroxy,  
5 halogen or methyl, R<sup>2</sup> signifies hydrogen or ethyl and R<sup>3</sup> signifies hydrogen, methyl or methoxy.

Some particularly preferred representatives of the class of substance defined by general formula I in the scope of the present  
10 invention are:

rac-trans-8-Ethyl-7-hydroxy-9-methoxy-2-methyl-  
1,3,4,4a, 5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one;  
rac-cis-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-  
15 benzo[h]isoquinolin-6-one;  
rac-cis-2,9-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo-  
[h]isoquinolin-6-one;  
rac-cis-7-chloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one;  
20 rac-cis-7-fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one;  
rac-cis-2,7,9-trimethyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one;  
(+)-trans-8-ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,  
25 5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one;  
(+)-cis-2,7-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo-  
[h]isoquinolin-6-one;  
(+)-cis-2,7,9-trimethyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one and  
30 (+)-cis-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
isoquinolin-6-one.

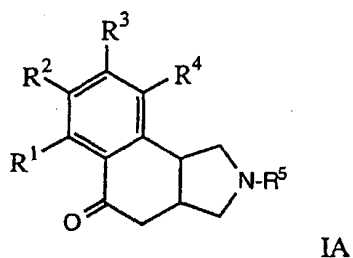
Compounds of general formula I as well as their pharmaceutically acceptable acid addition salts can be manufactured in  
35 according with the invention in a manner known per se by

a) cyclizing a compound of the general formula



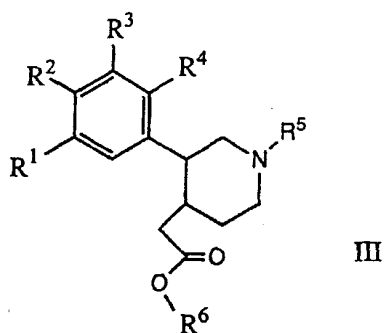
wherein R<sup>6</sup> signifies lower-alkyl,  
to a compound of the general formula

5



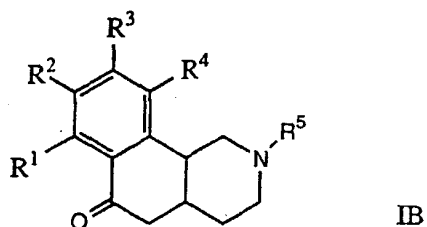
or

10 b) cyclizing a compound of the general formula



to a compound of the general formula

15



or

- c) alkylating or benzylating a compound of general formula I in  
5 which R<sup>5</sup> signifies hydrogen, or
- d) desalkylating a compound of general formula I in which R<sup>5</sup>  
signifies alkyl or benzyl, or
- 10 e) in a compound of general formula I in which at least one of  
R<sup>1</sup>-R<sup>4</sup> signifies an alkoxy group, converting this/these into (a)  
hydroxy group(s), and
- f) if desired, converting the compound of formula I obtained  
15 into a pharmaceutically acceptable acid addition salt.

In accordance with process variant a) the cyclization of a  
correspondingly substituted acetic acid ester of general formula  
II can be effected with polyphosphoric acid at a reaction  
20 temperature of about 120°C. Toluene is especially suitable as the  
solvent. Another cyclization method comprises the reaction of a  
corresponding ester with phosphorus oxychloride in the presence  
of a strong base.

25 The cyclization of a compound of formulae III to compounds  
of formulae IB (see Scheme 2) in accordance with variant b) is  
effected analogously to variant a). A mixture of polyphosphoric  
acid and toluene is reacted with a corresponding acetic acid ester  
for several hours at about 120°C and the product is subsequently  
30 purified according to known methods.

In accordance with process variant c) the alkylation or  
benzylation at the N atom of the ring nitrogen is effected with an  
alkyl or benzyl halide, preferably where methyl bromide, ethyl  
35 bromide, propyl bromide or benzyl bromide. Conveniently, a  
compound of general formula I in which R<sup>5</sup> signifies hydrogen is  
reacted with an aforementioned alkyl or benzyl halide in the

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presence of an alkaline salt, for example  $K_2CO_3$ , in anhydrous DMF and about 125°C.

The desalkylation at the N atom of the ring nitrogen is effected in accordance with process variant d) by treating a compound of general formula I in which  $R^5$  signifies alkyl in anhydrous chloroform and at room temperature with a cyanogen halide, preferably cyanogen bromide, subsequently heating under reflux and, after concentration under reduced pressure, again boiling under reflux with hydrochloric acid for several hours. Another possibility comprises treatment of a corresponding compound with 2,2,2-trichloroethyl chloroformate.

In accordance with process variant e) a compound of general formula I in which one of  $R^1$ - $R^4$  signifies an alkoxy group is converted into a compound of formula I in which one of  $R^1$ - $R^4$  signifies a hydroxy group. This is conveniently effected by converting the corresponding compound of formula I into the hydrochloride and subsequently converting the latter into the corresponding hydroxy compound at about -70°C using a  $BBr_3$  solution in methylene chloride.

It has been found that for a pharmaceutical use of these compounds their acid addition salts are especially well suited. The addition of the corresponding acids to the compounds of formula I is conveniently effected prior to their final isolation at the conclusion of the described manufacturing variants.

The compounds required as precursors for the manufacture of the compounds of formula I can be prepared according to Schemes 1 and 2.

Scheme 1 describes the manufacture of the compounds of formula I in which n signifies 0. The steps for the synthesis are described in detail in Example 1a-1h as an example for the manufacture of cis-7-ethyl-6-hydroxy-8-methoxy-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]isoindol-5-one.

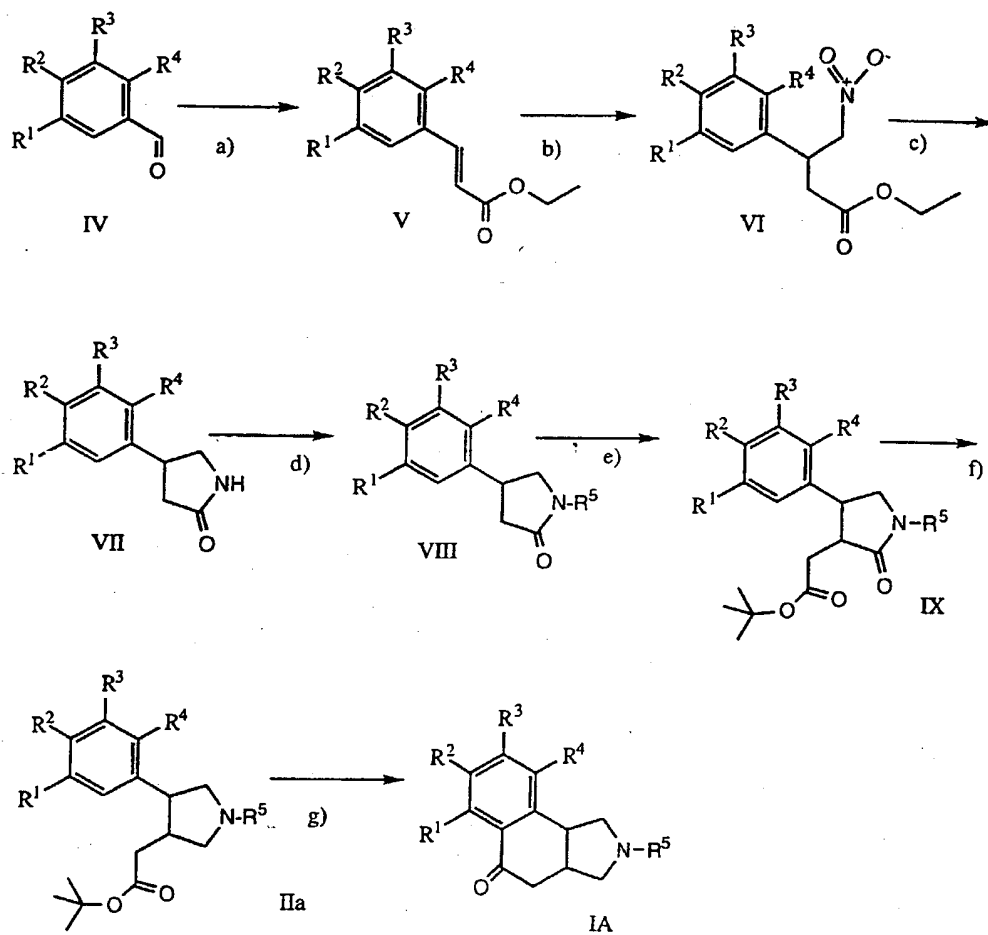


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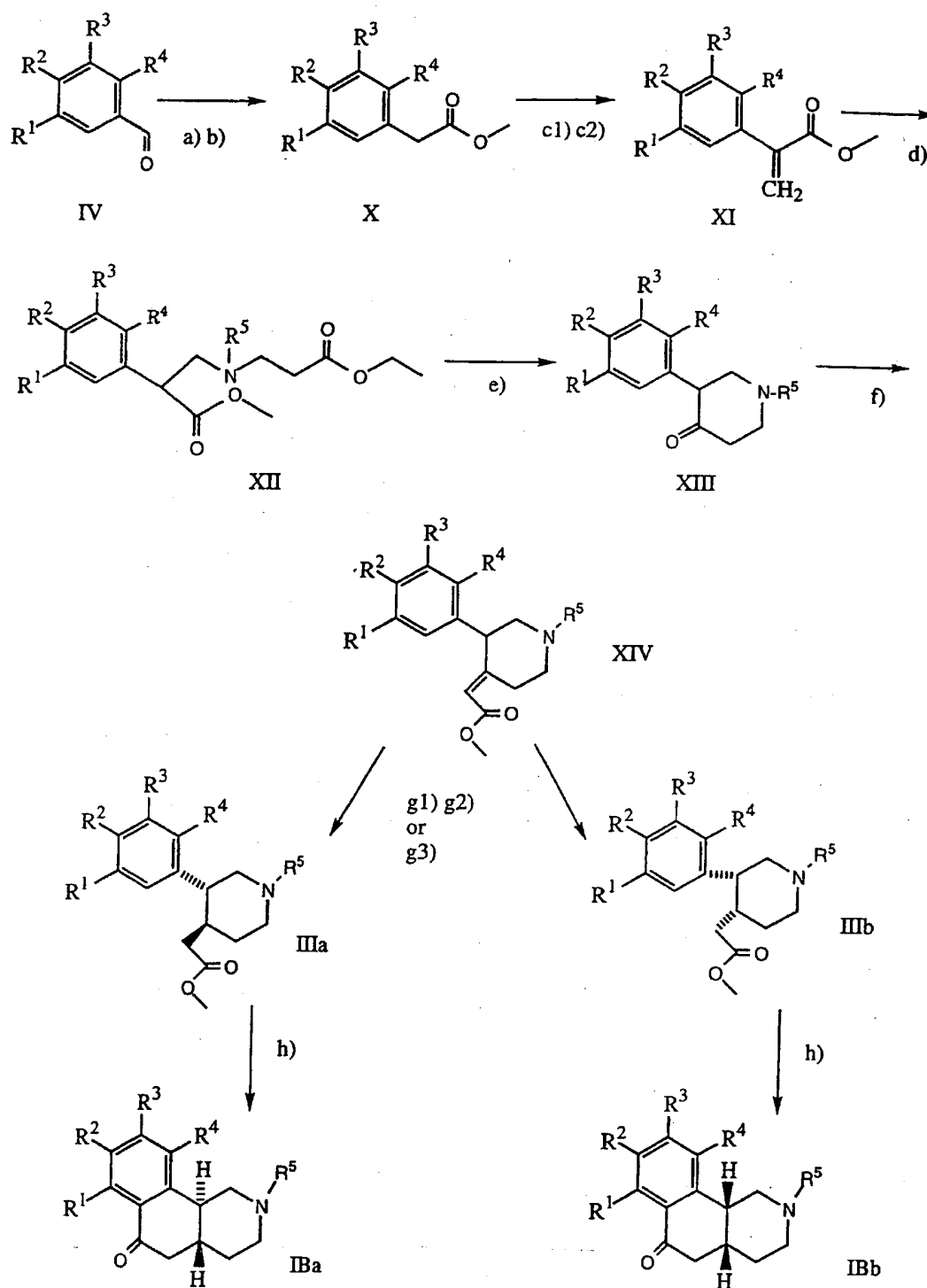
The manufacture of compounds of general formula I in which n signifies 1 is set forth in Formula Scheme 2. A detailed description for the manufacture of compounds of formulae IBa and IBb starting from a compound of general formula IV is described

5 in Example 8a-8i as a concrete example for trans-8-ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one.

Scheme 1 (according to Example 1)



Scheme 2 (according to Example 8)



-10

The binding of compounds of formula I in accordance with the invention to the serotonin receptors was determined in vitro by standard methods. The compounds were investigated in accordance with the assays given hereinafter:

5

a) for the binding to the 5HT<sub>2C</sub> receptor in accordance with the [3H]-5-HT binding assay according to the method of S.J. Peroutka et al., Brain Research 584, 191-196 (1992).

10 b) for the binding to the 5HT<sub>2A</sub> receptor in accordance with the [3H]-DOB binding assay according to the method of T. Branchek et al., Molecular Pharmacology 38, 604-609 (1990).

The (p<sub>Ki</sub> values p<sub>Ki</sub> = -log<sub>10</sub> K<sub>i</sub>) of the test compounds are  
15 given. The k<sub>i</sub> value is defined by the following formula:

$$K_i = \frac{IC_{50}}{1 + \frac{[L]}{K_D}}$$

in which the IC<sub>50</sub> values are those concentrations of test  
20 compounds in nM by which 50% of the receptor-bound ligands are displaced. [L] is the concentration of ligand and the K<sub>D</sub> value is the dissociation constant of the ligand.

The thus-determined activity of some compounds in  
25 accordance with the invention will be evident from the following Table:

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Compound	Example	Test method	
		a 5HT <sub>2A</sub>	b 5HT <sub>2C</sub>
A	8	6.90	7.98
B	13	<5	7.22
C	15	5.17	7.26
D	17	6.2	7.86
E	31	<5	7.57
F	41	5.96	7.61
G	43	7.21	8.47
H	44	<5	7.00
I	46	<5	7.84
J	47	5.83	7.32
K	48	5.13	8.14

- A = rac-trans-8-Ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one
- 5 B = rac-7-Methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one
- C = rac-cis-2,9-Dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one
- D = rac-cis-7-Chloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one
- 10 E = rac-cis-7-Fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one
- F = rac-cis-2,7,9-Trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one
- 15 G = (+)-trans-8-Ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinoline
- H = (+)-cis-7-Methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one
- I = (+)-cis-2,7-Dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one
- 20 J = (+)-cis-2,7,9-Trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one
- K = (+)-cis-2-Methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

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The compounds of formula I and the pharmaceutically acceptable acid addition salts of the compounds of formula I can be used as medicaments, e.g. in the form of pharmaceutical preparations. The pharmaceutical preparations can be administered orally, e.g. in the form of tablets, coated tablets, dragées, hard and soft gelatine capsules, solutions, emulsions or suspensions. The administration can, however, also be effected rectally, e.g. in the form of suppositories, parenterally, e.g. in the form of injection solutions, or nasally.

The compounds of formula I and the pharmaceutically acceptable acid addition salts of the compounds of formula I can be processed with pharmaceutically inert, inorganic or organic carriers for the production of pharmaceutical preparations. Lactose, corn starch or derivatives thereof, talc, stearic acid or its salts and the like can be used, for example, as such carriers for tablets, coated tablets, dragées and hard gelatine capsules. Suitable carriers for soft gelatine capsules are, for example, vegetable oils, waxes, fats, semi-solid and liquid polyols and the like. Depending on the nature of the active substance no carriers are, however, usually required in the case of soft gelatine capsules. Suitable carriers for the production of solutions and syrups are, for example, water, polyols, glycerol, vegetable oils and the like. Suitable carriers for suppositories are, for example, natural or hardened oils, waxes, fats, semi-liquid or liquid polyols and the like.

The pharmaceutical preparations can, moreover, contain preservatives, solubilizers, stabilizers, wetting agents, emulsifiers, sweeteners, colorants, flavorants, salts for varying the osmotic pressure, buffers, masking agents or antioxidants. They can also contain still other therapeutically valuable substances.

Medicaments containing a compound of formula I or a pharmaceutically acceptable acid addition salt thereof and a therapeutically inert carrier are also an object of the present

invention, as is a process for their production which comprises bringing one or more compounds of formula I and/or pharmaceutically acceptable acid addition salts into a galenical administration form together with one or more therapeutically inert carriers.

In accordance with the invention compounds of general formula I as well as their pharmaceutically acceptable acid addition salts can be used in the treatment or prevention of central nervous disorders such as depressions, bipolar disorders, anxiety states, sleep and sexual disorders, psychoses, schizophrenia, migraine and other conditions associated with cephalic pain or pain of a different kind, personality disorders or obsessive-compulsive disorders, social phobias or panic states, mental organic disorders, mental disorders in childhood, aggressivity, age-related memory disorders and behavioural disorders, addiction, obesity, bulimia etc.; nervous system damage caused by trauma, stroke, neurodegenerative diseases etc; cardiovascular disorders such as hypertension, thrombosis, stroke etc.; and gastrointestinal disorders such as dysfunction of the gastrointestinal tract motility and, respectively, for the production of corresponding medicaments. The dosage can vary within wide limits and will, of course, be fitted to the individual requirements in each particular case. In the case of oral administration the dosage lies in a range of about 0.01 mg to about 500 mg of a compound of general formula I or the corresponding amount of a pharmaceutically acceptable acid addition salt thereof, although the upper limit can also be exceeded when this is found to be indicated. The daily dosage can be administered as a single dosage or divided into several single dosages.

The following Examples illustrate the present example invention in more detail. However, they are not intended to limit its scope in any manner. All temperatures are given in degrees Celsius.

14  
Example 1

cis-7-Ethyl-6-hydroxy-8-methoxy-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]isoindol-5-one

- 5 a) 39.4 ml (63 mmol) of a 1.6N solution of n-butyllithium in hexane were added over a period of 15 minutes while stirring at -40° to a suspension of 28.3 g (66 mmol) of ethoxycarbonylmethyl-triphenylphosphonium bromide in 200 ml of tetrahydrofuran. The reaction mixture was stirred at 0° for one
- 10 hour, cooled to -70° and treated dropwise over 30 minutes with a solution of 11.6 g (60 mmol) of 4-ethyl-3,5-dimethoxy-benzaldehyde in 100 ml of tetrahydrofuran. Subsequently, the mixture was stirred at room temperature for a further 16 hours, poured into 600 ml of saturated sodium
- 15 chloride solution and extracted twice with 800 ml of diethyl ether each time. The combined organic phases were washed once with 600 ml of saturated sodium chloride solution, dried (MgSO<sub>4</sub>) and concentrated in a vacuum. The crude product obtained was purified by column chromatography on silica gel
- 20 (hexane/ethyl acetate 5:1). 12.5 g (79%) of ethyl 3-(4-ethyl-3,5-dimethoxy-phenyl)-acrylate were obtained as a white solid.
- b) A mixture of 12.5 g (47.3 mmol) of ethyl (4-ethyl 3,5-dimethoxy-phenyl)-acrylate, 40 ml of nitromethane and 10 ml of a 40% solution of Triton B in methanol was stirred at 60°
- 25 over 15 hours. Subsequently, the reaction mixture was poured on to 50 ml of ice and 50 ml of 3N sulphuric acid and extracted twice with 300 ml of ethyl acetate each time. The combined organic phases were washed twice with 100 ml of saturated sodium chloride solution each time, dried (MgSO<sub>4</sub>) and concentrated in a vacuum. 15.1 g (98%) of ethyl 3-(4-ethyl-3,5-
- 30 dimethoxy-phenyl)-4-nitro-butanoate were obtained as a yellow oil.
- c) 15.1 g (46.4 mmol) of ethyl 3-(4-ethyl-3,5-dimethoxy-phenyl)-4-nitro-butanoate dissolved in 300 ml of ethanol were
- 35 hydrogenated on Raney-nickel while stirring over a period of 2.5 hours. The catalyst was filtered off, washed several times



- 15
- with ethanol and the combined ethanol phases were concentrated in a vacuum to a volume of 200 ml. The reaction mixture was treated with 1.7 g of sodium acetate and 50 mg of p-toluenesulphonic acid and heated under reflux over
- 5 24 hours. Subsequently, the mixture was concentrated in a vacuum and the residue was purified by column chromatography on silica gel (methylene chloride/methanol 19:1). 8.85 g (76%) of 4-(4-ethyl-3,5-dimethoxy-phenyl)-pyrrolidin-2-one were obtained as a beige solid with m.p. 156°.
- 10 d) 3.12 g (78 mmol) of a sodium hydride dispersion (60% in oil) were added using a spatula and while stirring to a suspension of 8.85 g (35.5 mmol) of 4-(4-ethyl-3,5-dimethoxy-phenyl)-pyrrolidin-2-one in 250 ml of tetrahydrofuran and 2 ml of dimethylformamide and the mixture was stirred at
- 15 room temperature for a further hour. Thereafter, the reaction mixture was treated with 3.52 ml (106.5 mmol) of methyl iodide and left to stir at room temperature for a further 16 hours. Subsequently, the reaction mixture was poured on to 400 ml of ice-water and extracted twice with 600 ml of ethyl
- 20 acetate each time. The combined organic phases were washed twice with 300 ml of saturated sodium chloride solution each time, dried (MgSO<sub>4</sub>) and concentrated in a vacuum. The crude product was purified by column chromatography on silica gel (methylene chloride/methanol 39:1). 8.08 g (86%) of 4-(4-
- 25 ethyl-3,5-dimethoxy-phenyl)-1-methyl-pyrrolidin-2-one were obtained as a beige solid.
- e) A solution of LDA in 20 ml of anhydrous tetrahydrofuran, freshly prepared at 0° from 1.35 ml (9.5 mmol) of diisopropylamine and 5.93 ml (9.5 mmol) of a 1.6N solution of n-butyl-
- 30 lithium in hexane, was added dropwise while stirring to a solution, cooled to -70°, of 2 g (7.6 mmol) of 4-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-pyrrolidin-2-one in 20 ml of anhydrous tetrahydrofuran. The mixture was stirred at -70° for a further 30 minutes and subsequently a solution of 1.23 ml
- 35 (8.35 mmol) of tert.-butyl bromoacetate in 20 ml of tetrahydrofuran was added dropwise thereto over 30 minutes. Thereafter, the mixture was stirred for a further 22 hours

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without removal of the cooling bath, with the temperature slowly coming to room temperature. The mixture was poured on to 150 ml of ice-water and extracted twice 250 ml of ethyl acetate each time. The combined organic phases were washed  
5 once with saturated sodium chloride solution, dried (MgSO<sub>4</sub>) and concentrated in a vacuum. The crude product obtained was purified by column chromatography on silica gel (ethyl acetate). In addition to 0.54 g of educt there were obtained 1.23 g (43% and, respectively, 58% based on the conversion) of tert-butyl-  
10 (4-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-2-oxo-pyrrolidin-3-yl)-acetate as a pale yellow oil.

f) A solution of 1.23 g (3.26 mmol) of tert-butyl (4-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-2-oxo-pyrrolidin-3-yl)-acetate in 20 ml of tetrahydrofuran was treated at room  
15 temperature while stirring with 32.6 ml (32.6 mmol) of a 1M borane-THF complex solution and subsequently heated under reflux for 7 hours. Thereafter the reaction mixture was cooled to 0°, 10 ml of methanol were slowly added dropwise thereto and the mixture was concentrated in a vacuum. The residue was  
20 purified by column chromatography on silica gel (ethyl acetate). 0.9 g (76%) of tert.-butyl 4-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-2-oxo-pyrrolidin-3-yl)-acetate was obtained as a colourless oil.

g) A mixture of 1.08 g (2.97 mmol) of tert.-butyl 4-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-2-oxo-pyrrolidin-3-yl)-acetate and 11 g of polyphosphoric acid was stirred at 120°  
25 over 75 minutes. The reaction mixture was subsequently adjusted to pH 6 with 28% NaOH and sodium acetate and extracted three times with 100 ml of methylene chloride each  
30 time. The combined organic phases were washed once with 50 ml of saturated sodium chloride solution, dried (MgSO<sub>4</sub>) and concentrated in a vacuum. The crude product obtained was purified by column chromatography on silica gel (methylene chloride/methanol/NH<sub>4</sub>OH 15:1:0.1). 0.4 g (49%) of cis 7-ethyl-  
35 6-hydroxy-8-methoxy-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]isoindol-5-one was obtained as a colourless oil.

- 17
- h) 168 mg (1.45 mmol) of fumaric acid and 50 ml of diethyl ether were added while stirring to a solution of 0.4 g (1.45 mmol) of cis-7-ethyl-6-hydroxy-8-methoxy-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]isoindol-5-one in 0.5 ml of ethanol. The mixture was stirred at room temperature for a further 17 hours and the solid was subsequently filtered off. 0.55 g (97%) of 7-ethyl-6-hydroxy-8-methoxy-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]isoindol-5-one fumarate (1:1) was obtained as a white solid with m.p. 195°.

10

### Example 2

#### cis-7-Ethyl-6,8-dimethoxy-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]isoindol-5-one

15

- a) A mixture of 150 mg (0.41 mmol) of (4-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-pyrrolidin-3-yl)-acetate, 1.5 ml trifluoroacetic acid and 0.15 ml of trifluoroacetic acid anhydride was stirred at room temperature over 2 hours. The reaction mixture was subsequently poured on to 50 ml of ice-water, made basic with 28% NaOH and extracted twice with 100 ml of methylene chloride each time. The combined organic phases were washed once with 50 ml of saturated sodium chloride solution, dried (MgSO<sub>4</sub>) and concentrated in a vacuum. The crude product obtained was purified by column chromatography on silica gel (methylene chloride/methanol/NH<sub>4</sub>OH 15:1:0.1). 15 mg (13%) of cis-7-ethyl-6,8-dimethoxy-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]isoindol-5-one were obtained as a colourless oil.
- b) 6 mg (0.05 mmol) of fumaric acid 10 ml of hexane and 10 ml of diethyl ether were added while stirring to a solution of 15 mg (0.05 mmol) of cis-7-ethyl-6,8-dimethoxy-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]isoindol-5-one in 0.1 ml of ethanol. The mixture was stirred at room temperature for a further 2 hours and the solid was subsequently filtered off. 15 mg (75%) of cis-7-ethyl-6,8-dimethoxy-2-methyl-1,2,3,3a, 4,9b-hexahydro-benzo[e]isoindol-5-one fumarate (1:1) were obtained as a beige solid with m.p. 148°.

### Example 3

5 cis-8-Methoxy-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]-  
isoindol-5-one

In an analogous manner to that described in Example 1 d)-h), from 4-(3-methoxy-phenyl)-pyrrolidin-2-one there was obtained cis-8-methoxy-2-methyl-1,2,3,3a,4,9b-hexahydro-  
10 benzo[e]isoindol-5-one fumarate (1:1) as a white solid with m.p. 193°.

### Example 4

15 cis-2,8-Dimethyl-1,2,3,3a,4,9b-hexahydro-benzo[e]isoindol-5-one

In an analogous manner to that described in Example 1 b)-h), from ethyl 3-(3-methyl-phenyl)-acrylate there was  
20 obtained cis-2,8-dimethyl-1,2,3,3a,4,9b-hexahydro-benzo[e]-isoindol-5-one fumarate (1:1) as a white solid with m.p. 153°.

### Example 5

25 cis-8-Chloro-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]-  
isoindol-5-one

In an analogous manner to that described in Example 1 b)-h), from ethyl 3-(3-chloro-phenyl)-acrylate there was obtained  
30 cis-8-chloro-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]-isoindol-5-one fumarate (1:0.5) as a white solid with m.p. 213°.

### Example 6

35 cis-2-Methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]isoindol-5-one

In an analogous manner to that described in Example 1e)-h), from 1-methyl-4-phenyl-pyrrolidin-2-one there was

obtained cis-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]-  
isoindol-5-one fumarate (1:0.5) as a white solid with m.p. 203°. 19

### Example 7

5

cis-7-Methoxy-2-methyl-1,2,3,3a,4,9b-hexahydro-benzo[e]-  
isoindol-5-one

In an analogous manner to that described in Example 1 e)-  
10 h), from 4-(4-methoxy-phenyl)-1-methyl-pyrrolidin-2-one  
there was obtained cis-7-methoxy-2-methyl-1,2,3,3a,4,9b-  
hexahydro-benzo[e]isoindol-5-one fumarate (1:1) as a white  
solid with m.p. 173°.

15

### Example 8

trans-8-ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-  
hexahydro-2-H-benzo[h]isoquinoline-6-one

20 a) 130 ml of a 40% solution of benzyltrimethylammonium  
hydroxide in methanol (Triton B) were added to a solution of 126.5 g  
(651.2 mmol) of 4-ethyl-3,5-dimethoxy-benzaldehyde and 80.89 g  
(651.2 mmol) of methyl methylthiomethyl sulphoxide in 300 ml of  
tetrahydrofuran and the mixture was heated at reflux for 5 hours.  
25 After the addition of 300 ml of methylene chloride the mixture was  
extracted with 200 ml of 0.5M sulphuric acid. The organic phase  
was dried (MgSO<sub>4</sub>), filtered and evaporated. Chromatography of the  
resulting residue (silica gel, ethyl acetate/hexane 1:1) yielded  
134.6 g (69%) of (E)-2-ethyl-5-(2-methylsulphanyl-2-methyl-  
30 sulphanyl-vinyl)-1,3-dimethoxybenzene as a colourless oil, which  
gave colourless crystals of m.p. 82-83° by crystallization from  
hexane.

b) 400 ml of a concentrated methanolic hydrochloric acid  
35 solution were added to a solution of 130.0 g (433 mmol) of (E)-  
2-ethyl-5-(2-methylsulphanyl-2-methylsulphanyl-vinyl)-1,3-  
dimethoxybenzene in 200 ml of methanol and the mixture was  
stirred at 50° for 4 hours. Subsequently, the methanol was

- evaporated and the residue was partitioned between 300 ml of methylene chloride and 200 ml of sat. sodium hydrogen carbonate solution. The aqueous phase was washed twice with 200 ml of methylene chloride and the organic phases were dried ( $\text{MgSO}_4$ ), filtered and evaporated. Chromatography of the residue (silica gel, ethyl acetate/hexane 1:9) yielded 100.5 g (94%) of methyl (4-ethyl-3,5-dimethoxy-phenyl)-acetate as a colourless wax,  $R_f = 0.345$  (silica gel, ethyl acetate/hexane 1:9).
- c 1) A solution of 80.43 g (337.5 mmol) of methyl (4-ethyl-3,5-dimethoxy-phenyl)-acetate in 400 ml of toluene was added dropwise to a suspension of 22.1 g (506 mmol) of NaH (55% in mineral oil) in 400 ml of tetrahydrofuran and 40.86 g (346 mmol) of dimethyl oxalate and the mixture was stirred at room temperature for 65 hours. The reaction mixture was poured on to 300 ml of ice-water and washed twice with 250 ml of diethyl ether. The aqueous phase was adjusted to pH 1 with 25% HCl and extracted three times with 300 ml of diethyl ether. The combined phases were dried ( $\text{MgSO}_4$ ), filtered and evaporated. The thus-obtained dimethyl 2-(4-ethyl-3,5-dimethoxy-phenyl)-3-oxo-succinate (101.9 g, 314.3 mmol) was suspended in 150 ml of water and treated with 61 ml (812 mmol) of formaldehyde solution (37% in water). Subsequently, a solution of 43.4 g of potassium carbonate in 150 ml of water was slowly added dropwise thereto and the mixture was stirred at room temperature for 12 hours and then extracted three times with 250 ml of diethyl ether. The combined organic phases were dried ( $\text{MgSO}_4$ ), filtered and evaporated. Chromatography of the resulting residue (silica gel, hexane/methylene chloride 1:2) gave 44.5 g (53%) of methyl 2-(4-ethyl-3,5-dimethoxy-phenyl)-acrylate as a colourless wax,  $R_f = 0.635$  (silica gel, methylene chloride/hexane 2:1).
- c 2) 18.9 g (630 mmol) of paraformaldehyde, 92.8 g (672 mmol) of potassium carbonate and 3.1 g (8.4 mmol) of tetrabutylammonium iodide were added to a solution of 100 g (420 mmol) of methyl 2-(4-ethyl-3,5-dimethoxy-phenyl)-acrylate in 200 ml of toluene and the mixture was heated to 80°

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- for 6 hours and then cooled and treated with 150 ml of water. The phases were separated and the aqueous phase was extracted twice with 120 ml of toluene. The combined organic phases were dried ( $\text{MgSO}_4$ ), filtered and evaporated. Chromatography of the
- 5 resulting residue (silica gel, hexane/methylene chloride 2:1) gave 70.5 g (67%) of methyl 2-(4-ethyl-3,5-dimethoxy-phenyl)-acrylate as a colourless wax,  $R_f = 0.635$  (silica gel, methylene chloride/hexane 2:1).
- 10 d) A solution of 78.4 g (313 mmol) of methyl 2-(4-ethyl-3,5-dimethoxy-phenyl)-acrylate and 47.7g (364 mmol) of ethyl 3-methylamino-propionate was stirred at room temperature for 48 hours. Chromatography of the reaction mixture (silica gel, ethyl acetate/hexane 1:1) and crystallization from hexane gave
- 15 71.1 g (59%) of methyl 3-[(2-ethoxycarbonyl-ethyl)-methyl-amino]-2-(4-ethyl-3,5-dimethoxy-phenyl)-propionate as colourless crystals of m.p. 74-75°.
- e) A solution of 53.51 g (140.3 mmol) of methyl 3-[(2-ethoxycarbonyl-ethyl)-methyl-amino]-2-(4-ethyl-3,5-dimethoxy-
- 20 phenyl)-propionate in 150 ml of toluene was added dropwise at 80° to a suspension of 11.62 g (266.3 mmol) of sodium hydride (55% in mineral oil) in 150 ml of toluene and the mixture was subsequently heated at reflux for 15 hours. The solution was
- 25 cooled to room temperature and adjusted to pH 1 with 6N hydrochloric acid. The toluene was separated and extracted once with 150 ml of 6N hydrochloric acid. The acidic phases were heated at reflux for 20 hours. After cooling to room temperature the mixture was adjusted to pH 14 with 28% NaOH and extracted
- 30 three times with 250 ml of methylene chloride. The organic phases were washed once with 200 ml of water and once with 200 ml of saturated sodium chloride solution, dried ( $\text{MgSO}_4$ ), filtered and evaporated. Chromatography (silica gel, methylene chloride/methanol 19:1) and recrystallization from hexane
- 35 yielded 34.4 g (88%) of 3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-one as pale yellow crystals of m.p. 84-85°.

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f) A solution of 39 ml (262.4 mmol) of trimethyl phosphonoacetate in 450 ml of tetrahydrofuran was added dropwise at 0° to a suspension of 9.54 g (238.5 mmol) of sodium hydride (55% in mineral oil) in 450 ml of tetrahydrofuran and the mixture was stirred for 30 minutes. Subsequently, the white suspension was treated with a solution of 33.15 g (119.5 mmol) of 3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-one in 450 ml of tetrahydrofuran and the mixture was stirred at 50° for 2 hours. After cooling to room temperature the mixture was poured on to 500 ml of ice-water and extracted three times with 400 ml of diethyl ether. The organic phases were washed with 400 ml of water and 400 ml of saturated sodium chloride solution, dried (Na<sub>2</sub>SO<sub>4</sub>), filtered and evaporated. Chromatography (silica gel, methylene chloride/methanol 19:1) and recrystallization from hexane yielded 36.33 g (91%) of methyl (E)-[3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-ylidene]acetate as pale yellow crystals of m.p. 110-112°.

g 1) 25.76 g (1060 mmol) of magnesium shavings were added to a solution of 35.33 g (106 mmol) of methyl (E)-[3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-ylidene]acetate in 850 ml of methanol and the mixture was stirred at room temperature for 2 hours. The solution was filtered over Dicalite and evaporated. The residue was partitioned between 300 ml of methylene chloride and 500 ml of saturated ammonium chloride solution. The aqueous phase was extracted three times with 250 ml of methylene chloride. The organic phase was dried (Na<sub>2</sub>SO<sub>4</sub>), filtered and evaporated. Chromatography (silica gel, ethyl acetate/methanol/NH<sub>4</sub>OH 200:10:1) yielded 7.16 g (20%) of methyl cis-[3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-yl]-acetate as a colourless oil, R<sub>f</sub> = 0.23 ((silica gel, ethyl acetate/methanol/ NH<sub>4</sub>OH 200:10:1) and 23.51 g (66%) of methyl-[3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-yl]-acetate as a colourless oil, R<sub>f</sub> = 0.12 (silica gel, ethyl acetate/methanol/NH<sub>4</sub>OH 200:10:1).

g 2) A solution of 11.7 g (35.3 mmol) of methyl (E)-[3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-ylidene]acetate in



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100 ml of methanol was treated with 500 mg of Pd on charcoal and hydrogenated with hydrogen at room temperature for 12 hours. The catalyst was filtered off and the filtrate was evaporated. Chromatography (silica gel, ethyl acetate/methanol/  
5 NH<sub>4</sub>OH 200:10:1) yielded 9.14 g (77%) of methyl cis-[3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-yl]-acetate as a colourless oil, R<sub>f</sub> = 0.23 (silica gel ethyl acetate methanol/NH<sub>4</sub>OH 200:10:1) and 2.56 g (21%) of methyl trans-[3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-yl]-acetate as a colour-  
10 less oil, R<sub>f</sub> = 0.12 (silica gel, ethyl acetate/methanol/NH<sub>4</sub>OH 200:10:1).

g 3) A solution of 6.4 g (19.3 mmol) of methyl (E)-[3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-ylidene]acetate in  
15 100 ml of methanol was treated with 1.08 g (20 mmol) of sodium methylate and the mixture was heated at reflux for 6 hours. The solution was evaporated and the residue was partitioned between 50 ml of methyl acetate and 50 ml of water. The organic phases were dried (MgSO<sub>4</sub>), filtered and evaporated.  
20 The colourless oil was dissolved in 50 ml of methanol, treated with 125 mg of Pd on charcoal and hydrogenated with hydrogen at room temperature for 12 hours. The catalyst was filtered off and the filtrate was evaporated. Chromatography (silica gel, ethyl acetate/methanol/NH<sub>4</sub>OH 200:10:1) yielded 5.68 g (88%) of methyl  
25 cis-[3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-yl]-acetate as a colourless oil, R<sub>f</sub> = 0.23 (silica gel, ethyl acetate/methanol/NH<sub>4</sub>OH 200:10:1).

h) A mixture of 140 g of polyphosphoric acid and 50 ml of  
30 toluene was heated to 120° and treated with a solution of 13.9 g (41.5 mmol) of methyl cis-[3-(4-ethyl-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-yl]-acetate in 120 ml of toluene. The reaction mixture was stirred at 120° for 3 hours and poured slowly into 500 ml of water at 80°. The mixture was adjusted to  
35 pH = 12 with 28% sodium hydroxide solution and extracted three times with 300 ml of ethyl acetate. The organic phase was dried (Na<sub>2</sub>SO<sub>4</sub>), filtered and evaporated. Chromatography (silica gel, methylene chloride/methanol/NH<sub>4</sub>OH 110:10:1) gave 8.64 g (68%)

of trans-8-ethyl-7,9-dimethoxy-2-methyl-1,3,4,4a,5,10b-<sup>24</sup>  
hexahydro-2H-benzo[h]isoquinolin-6-one as a colourless oil, R<sub>f</sub> =  
0.32 (silica gel, methylene chloride/methanol/NH<sub>4</sub>OH 110:10:1),  
which was converted with fumaric acid into the fumarate (1:1)  
5 with m.p. 194-195.5°.

i) 3.9 (13 mmol) of trans-8-ethyl-7,9-dimethoxy-2-methyl-  
1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one were  
converted with HCl in ethyl acetate into the hydrochloride and the  
10 latter was subsequently dissolved in 280 ml of methylene  
chloride. The solution was cooled to -70° and treated with  
15.4 ml of a 1M BBr<sub>3</sub> solution in methylene chloride. After  
15 minutes the cooling bath was removed. After the solution had  
reached room temperature it was stirred for one hour, subse-  
15 quently poured on to 200 ml of ice/sat. sodium hydrogen  
carbonate solution and extracted three times with 250 ml of  
methylene chloride. The organic phases were dried (Na<sub>2</sub>SO<sub>4</sub>),  
filtered and evaporated. Chromatography (silica gel, methylene  
chloride/methanol/NH<sub>4</sub>OH 110:10:1) yielded 2.50 g (67%) of trans-  
20 8-ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexa-  
hydro-2H-benzo[h]isoquinolin-6-one, which was converted with  
fumaric acid into the fumarate (1:1) with m.p. 201-203°.

### Example 9

25

cis-8-Ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-  
hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 1 h)  
30 and i), from cis-8-ethyl-7,9-dimethoxy-2-methyl-1,3,4,4a,  
5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one there was  
obtained cis-8-ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,  
4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was  
converted with fumaric acid into the fumarate (1:1) with m.p.  
35 221-223°.

25  
Example 10

trans-8-Bromo-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

- 5
- a) 2 ml of 1N NaOH solution were added to a solution of 0.726 g (1.87 mmol) of methyl trans-[3-(4-bromo-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-yl]-acetate in 3 ml of ethanol and the mixture was stirred at 50° for 30 minutes. The
- 10 solution was evaporated and the residue was dried in a high vacuum. The thus-obtained sodium salt was suspended in 5 ml of acetonitrile. After the addition of 278 mg (2 mmol) of potassium carbonate the suspension was treated at 0° with 0.913 ml (10 mmol) of phosphorus oxychloride and the mixture
- 15 was subsequently stirred at 50° for 2 hours. Subsequently, the mixture was poured into 10 ml of water, adjusted to pH = 12 with 28% NaOH and extracted three times with 15 ml of ethyl acetate. The organic phase was dried (Na<sub>2</sub>SO<sub>4</sub>), filtered and evaporated. Chromatography (silica gel, methylene chloride/
- 20 methanol 95:5) yielded 0.385 g (58%) of trans-8-bromo-7,9-dimethoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one, which was converted with HCl in methanol into the hydrochloride with m.p. 226-228°.
- 25 b) A solution of 0.421 g (1.11 mmol) of trans-8-bromo-7,9-dimethoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one hydrochloride in 40 ml of methylene chloride was treated at -70° with 1.23 ml of a 1M BBr<sub>3</sub> solution in methylene chloride. After 15 minutes the cooling bath was
- 30 removed. After the solution had reached room temperature it was stirred for one hour, subsequently poured on to 80 ml of ice/sat. sodium hydrogen carbonate solution and extracted three times with 60 ml of methylene chloride. The organic phase was dried (Na<sub>2</sub>SO<sub>4</sub>), filtered and evaporated. Chroma-
- 35 ography (silica gel, methylene chloride/methanol 9:1) yielded 0.315 g (83%) of trans-8-bromo-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-

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one, which was converted with HCl in methanol into the hydrochloride with m.p. 257-259°.

The methyl [3-(4-bromo-3,5-dimethoxy-phenyl)-1-methyl-piperidin-4-yl]-acetate used was prepared from 4-bromo-3,5-dimethoxybenzaldehyde in an analogous manner to that described in Example 8a), b), c 1), d), e), f) and g 1).

### Example 11

10

trans-7-Hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 8 c1), d), e), f), g 1), h) and i), from methyl (3,5-dimethoxy-phenyl)-acetate there was obtained trans-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one, which was converted with HCl in methanol into the hydrochloride with m.p. > 250°.

20

### Example 12

cis-2-Methyl-1,3,4,4a,5,11b-hexahydro-2H-8,10-dioxo-2-azacyclopenta[b]phenanthren-6-one

25

In an analogous manner to that described in Example 10 a), from methyl cis-(3-benzo[1,3]dioxol-5-yl-1-methyl-piperidin-4-yl)-acetate there was obtained cis-2-methyl-1,3,4,4a,5,11b-hexahydro-2H-8,10-dioxo-2-aza-cyclopenta[b]-phenanthren-6-one, which was converted with fumaric acid into the fumarate (1:0.75) with m.p. > 250°.

30

The methyl cis-(3-benzo[1,3]dioxol-5-yl-1-methyl-piperidin-4-yl)-acetate used was prepared in an analogous manner to that described in Example 8 f) and g 3) from 3-benzo[1,3]dioxol-5-yl-1-methyl-piperidin-4-one.

35

27  
Example 13

cis-9-Methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo-  
[h]isoquinolin-6-one and cis-7-methoxy-2-methyl-1,3,4,4a,5,  
5 10b-hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 8 f),  
g 3) and h), from 3-(3-methoxy-phenyl)-1-methyl-piperidin-4-  
one there were obtained cis-9-methoxy-2-methyl-1,3,4,4a,5,  
10 10b-hexahydro-2H-benzo[h]isoquinolin-6-one and cis-7-  
methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
isoquinolin-6-one, which were converted with HCl in methanol  
into their hydrochlorides with m.p. > 250°.

15 Example 14

trans-9-Methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one

20 In an analogous manner to that described in Example 8 f),  
g 1) and h), from 3-(3-methoxy-phenyl)-1-methyl-piperidin-4-  
one there was obtained trans-9-methoxy-2-methyl-  
1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which  
was converted with HCl in methanol into the hydrochloride with  
25 m.p. > 250°.

Example 15

cis-2,9-Dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]iso-  
30 quinolin-6-one

In an analogous manner to that described in Example 8 d)  
e), f), g 3) and h), from methyl 2-m-tolyl-acrylate there was  
obtained cis-2,9-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-  
35 benzo[h]isoquinolin-6-one, which was converted with HCl in  
methanol into the hydrochloride with m.p. > 250°.

28  
Example 16

trans-2,9-Dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

5

In an analogous manner to that described in Example 8 d), e), f), g1) and h), from methyl 2-m-tolyl acrylate there was obtained trans-2,9-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with HCl in  
10 methanol into the hydrochloride with m.p. > 250°.

Example 17

cis-9-Chloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
15 isoquinolin-6-one.  
trans-9-chloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one.  
cis-7-chloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one and trans-7-chloro-2-methyl-  
20 1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 8 d), e), f), g 1) and h), from methyl 2-(3-chloro-phenyl)-acrylate there were obtained cis-9-chloro-2-methyl-1,3,4,4a,5,10b-  
25 hexahydro-2H-benzo[h]isoquinolin-6-one, trans-9-chloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, cis-7-chloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one and trans-7-chloro-2-methyl-  
1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one which  
30 were converted with HCl in methanol into their hydrochlorides with m.p. > 250°.

29  
**Example 18**

trans-8-Fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo-  
[h]isoquinolin-6-one

5

In an analogous manner to that described in Example 8 d), e), f), g 1) and h), from methyl 2-(4-fluoro-phenyl)-acrylate there was obtained trans-8-fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted  
10 with HCl in methanol into the hydrochloride with m.p. > 250°.

**Example 19**

cis-8-Fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
15 isoquinolin-6-one

In an analogous manner to that described in Example 8 d), e), f), g 3) and h), from methyl 2-(4-fluoro-phenyl)-acrylate there was obtained cis-8-fluoro-2-methyl-1,3,4,4a,5,10b-  
20 hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with HCl in methanol into the hydrochloride with m.p. > 250°.

**Example 20**

trans-2,8-Dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
25 isoquinolin-6-one

In an analogous manner to that described in Example 8 d), e), f), g 1) and h), from methyl 2-o-tolyl-acrylate there was  
30 obtained trans-2,8-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with HCl in methanol into the hydrochloride with m.p. > 250°.

30  
Example 21

cis-2,8-Dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

5

In an analogous manner to that described in Example 8 d), e), f), g 3) and h), from methyl 2-o-tolyl-acrylate there was obtained cis-2,8-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with HCl in  
10 methanol into the hydrochloride with m.p. > 250°.

Example 22

trans-8-Methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

15

In an analogous manner to that described in Example 8 f), g 1) and h), from 3-(4-methoxy-phenyl)-1-methyl-piperidin-4-one there was obtained trans-8-methoxy-2-methyl-1,3,4,4a,  
20 5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with HCl in methanol into the hydrochloride with m.p. 222°.

Example 23

25

cis-8-Methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 8 f),  
30 g 3) and h), from 3-(4-methoxy-phenyl)-1-methyl-piperidin-4-one there was obtained cis-8-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with HCl in methanol into the hydrochloride with m.p. > 250°.

35



31  
Example 24

trans-8-Ethyl-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo-  
[h]isoquinolin-6-one

5

In an analogous manner to that described in Example 8 d),  
e), f), g 1) and h), from methyl 2-(4-ethyl-phenyl)-acrylate  
there was obtained trans-8-ethyl-2-methyl-1,3,4,4a,5,10b-  
hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted  
10 with HCl in methanol into the hydrochloride with m.p. 226°.

Example 25

cis-8-Ethyl-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
15 isoquinolin-6-one

In an analogous manner to that described in Example 8 d),  
e), f), g 3) and h), from 2-(4-ethyl-phenyl)-acrylic acid ester  
there was obtained cis-8-ethyl-2-methyl-1,3,4,4a,5,10b-  
20 hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted  
with HCl in methanol into the hydrochloride with m.p. > 250°.

Example 26

25 trans-8-Chloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo-  
[h]isoquinolin-6-one and cis-8-chloro-2-methyl-1,3,4,4a,5,  
10b-hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 8 d),  
30 e), f), g 1) and h), from 2-(4-chloro-phenyl)-acrylic acid ester  
there were obtained trans-8-chloro-2-methyl-1,3,4,4a,5,10b-  
hexahydro-2H-benzo[h]isoquinolin-6-one and cis-8-chloro-2-  
methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-  
one, which were converted with HCl in methanol into their  
35 hydrochlorides with m.p. > 250°.

<sup>32</sup>  
Example 27

cis-7,9-Difluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

5

In an analogous manner to that described in Example 8 c 2), d), e), f), g 3) and h), from methyl 3,5-difluorophenyl-acetate there was obtained cis-7,9-difluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which  
10 was converted with HCl in methanol into the hydrochloride with m.p. > 230°.

Example 28

15 trans-7,9-Difluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 8 c 2), d), e), f), g 1) and h), from methyl 3,5-difluorophenyl-acetate there was obtained trans-7,9-difluoro-2-methyl-  
20 1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with HCl in methanol into the hydrochloride with m.p. > 220°.

25

Example 29

cis-7,9-Dichloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one and trans-7,9-dichloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

30

In an analogous manner to that described in Example 8 c 2), d), e), f), g 1) and h), from ethyl 3,5-dichlorophenyl-acetate there were obtained cis-7,9-dichloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one and  
35 trans-7,9-dichloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which were converted with HCl in methanol into their hydrochlorides with m.p. > 250°.

<sup>33</sup>  
Example 30

trans-9-Fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one and trans-7-fluoro-2-methyl-  
5 1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 8 c 2), d), e), f), g 1) and h), from ethyl 3-fluorophenylacetate there were obtained trans-9-fluoro-2-methyl-1,3,4,4a,5,10b-  
10 hexahydro-2H-benzo[h]isoquinolin-6-one and trans-7-fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which were converted with HCl in methanol into their hydrochlorides with m.p. > 250°.

15 Example 31

cis-9-Fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
isoquinolin-6-one and cis-7-fluoro-2-methyl-1,3,4,4a,5,10b-  
20 hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 8 c 2), d), e), f), g 3) and h), from ethyl 3-fluorophenyl acetate there were obtained cis-9-fluoro-2-methyl-1,3,4,4a,5,10b-  
25 hexahydro-2H-benzo[h]isoquinolin-6-one and cis-7-fluoro-2-methyl-1,3,4,4a, 5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which were converted with HCl in methanol into their hydrochlorides with m.p. > 250°.

30 Example 32

cis-2-Methyl-8-phenyl-1,3,4,4a,5,10b-hexahydro-2H-benzo-  
[h]isoquinolin-6-one

In an analogous manner to that described in Example 8 c 2), d), e), f), g 3) and h), from methyl (4-phenyl)-phenyl  
35 acetate there was obtained cis-2-methyl-8-phenyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which

was converted with HCl in methanol into the hydrochloride with<sup>34</sup>  
m.p. > 250°.

### Example 33

trans-2-Methyl-8-phenyl-1,3,4,4a,5,10b-hexahydro-2H-benzo-  
[h]isoquinolin-6-one

In an analogous manner to that described in Example 8  
c 2), d), e), f), g 1) and h), from methyl (4-phenyl)-phenyl  
acetate there was obtained trans-2-methyl-8-phenyl-1,3,4,  
4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was  
converted with HCl in methanol into the hydrochloride with m.p.  
> 250°.

### Example 34

cis-8,9-Difluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 8  
c 2), d), e), f), g 3) and h), from methyl 3,4-difluorophenyl-  
acetate there was obtained cis-8,9-difluoro-2-methyl-1,3,4,  
4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was  
converted with HCl in methanol into the hydrochloride with m.p.  
> 250°.

### Example 35

trans-8,9-Difluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 8  
c 2), d), e), f), g 1) and h), from methyl 3,3-difluoro-phenyl  
acetate there was obtained trans-8,9-difluoro-2-methyl-  
1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which  
was converted with HCl in methanol into the hydrochloride with  
m.p. > 250°.

**Example 36**

5 cis-10-Fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo-  
[h]isoquinolin-6-one

In an analogous manner to that described in Example 8 f),  
g 3) and h), from 3-(2-fluorophenyl)-1-methyl-piperidone  
there was obtained cis-10-fluoro-2-methyl-1,3,4,4a,5,10b-  
10 hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted  
with HCl in methanol into the hydrochloride with m.p. > 220°.

**Example 37**

15 trans-10-Fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 8 f),  
g 1) and h), from 3-(2-fluorophenyl)-1-methyl-piperidone there  
20 was obtained trans-10-fluoro-2-methyl-1,3,4,4a,5,10b-hexa-  
hydro-2H-benzo[h]isoquinolin-6-one, which was converted with  
HCl in methanol into the hydrochloride with m.p. > 220°.

25

**Example 38**

cis-10-Methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one and trans-10-methoxy-2-methyl-  
1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

30

In an analogous manner to that described in Example 8 d),  
e), f), g 2) and h), from methyl 2-(2-methoxy-phenyl)-acrylate  
there were obtained cis-10-methoxy-2-methyl-1,3,4,4a,5,10b-  
hexahydro-2H-benzo[h]isoquinolin-6-one and trans-10-  
35 methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
isoquinolin-6-one, which were converted with HCl in methanol  
into their hydrochlorides with m.p. > 220°.

36  
Example 39

cis-2,10-Dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

5

In an analogous manner to that described in Example 8 d), e), f), g 3) and h), from methyl 2-(2-methyl-phenyl)-acrylate there was obtained cis-2,10-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with  
10 HCl in methanol into the hydrochloride with m.p. > 220°.

Example 40

trans-2,10-Dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

15

In an analogous manner to that described in Example 8 d), e), f), g 1) and h), from methyl 2-(2-methyl-phenyl)-acrylate there was obtained trans-2,10-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with  
20 HCl in methanol into the hydrochloride with m.p. > 220°.

Example 41

trans-2,7,9-Trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

25

In an analogous manner to that described in Example 8 c 2), d), e), f), g 3) and h), from methyl (3,5-dimethyl-phenyl)-acetate there was obtained trans-2,7,9-trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was  
30 converted with HCl in methanol into the hydrochloride with m.p. > 250°.

37  
Example 42

cis-2,7,9-Trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one

5

In an analogous manner to that described in Example 8 c 2), d), e), f), g 1) and h), from methyl (3,5-dimethyl-phenyl)-acetate there was obtained cis-2,7,9-trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with  
10 HCl in methanol into the hydrochloride with m.p. > 250°.

Example 43

(-)-trans-8-Ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

15

3.08 g (8.6 mmol) of (+) -O,O-dibenzoyltartaric acid were added to a solution of 2.58 g (8.6 mmol) of trans-8-ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one in 40 ml of ethanol and the mixture  
20 was stirred at room temperature for 15 minutes. Subsequently, it was heated to reflux and sufficient ethanol was added thereto in order to give a clear solution (about 80 ml). After cooling to room temperature the resulting crystals (2.52 g) were filtered  
25 off and dissolved in a mixture of 50 ml of methylene chloride and 50 ml of 2N sodium carbonate solution. The sodium carbonate solution was washed once with methylene chloride. The organic phases were dried (MgSO<sub>4</sub>), filtered and evaporated. The yellow oil obtained (1.18 g) was converted with HCl in methanol into the  
30 hydrochloride. After recrystallization from diisopropyl ether/ethanol there was obtained 0.86 g of (+)-trans-8-ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one hydrochloride with m.p. 261-263,  $[\alpha]_{589} = +28.6$  (c = 0.5, H<sub>2</sub>O).

35

The mother liquor of the crystallization with (+) -O,O-dibenzoyltartaric acid was evaporated and the residue was partitioned between methylene chloride and a 2N sodium

38

carbonate solution. The aqueous phase was washed twice with methylene chloride and the organic phases were dried (MgSO<sub>4</sub>), filtered and evaporated. The thus-obtained light yellow oil (1.39 g (4.8 mmol)) was dissolved in 20 ml of ethanol and treated with 1.72 g (4.8 mmol) of (-)-O,O'-dibenzoyltartaric acid. Subsequently, the mixture was heated to reflux and sufficient ethanol was added thereto to give a clear solution (about 40 ml). After cooling to room temperature the resulting crystals (2.26 g) were filtered off and dissolved in a mixture of 50 ml of methylene chloride and 50 ml of 2N sodium carbonate solution. The sodium carbonate solution was washed once with methylene chloride. The organic phases were dried (MgSO<sub>4</sub>), filtered and evaporated. The thus-obtained yellow oil (1.22 g) was converted with HCl in methanol into the hydrochloride. After recrystallization from diisopropyl ether/ethanol there was obtained 0.82 g of (-)-trans-8-ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one hydrochloride with m.p. 261-263°, [α]<sub>589</sub> = -29.2 (c = 0.5, H<sub>2</sub>O).

20

#### Example 44

(+)-cis-7-Methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one  
25 (-)-cis-7-Methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 43, from cis-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one by crystallization with (+)-O,O'-dibenzoyltartaric acid there was obtained (+)-cis-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with HCl in methanol into the hydrochloride. After recrystallization from ethanol there was obtained (+)-cis-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one hydrochloride with m.p. >250°, [α]<sub>589</sub> = +2.6 (c = 0.5, H<sub>2</sub>O).

35



39

By crystallization with (-)-O,O-dibenzoyltartaric acid there was obtained (-)-cis-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with HCl in methanol into the hydrochloride. After  
5 recrystallization from ethanol there was obtained (-)-cis-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one hydrochloride with m.p. > 250°,  $[\alpha]_{589} = -2.4$  (c = 0.5, H<sub>2</sub>O).

10

#### Example 45

(-)-trans-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

15 In an analogous manner to that described in Example 43, from trans-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one by crystallization with (+)-O,O'-dibenzoyltartaric acid there was obtained (+)-trans-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]iso-  
20 quinolin-6-one, which was converted with HCl in methanol into the hydrochloride. After recrystallization from ethanol there was obtained (+)-trans-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one hydrochloride with m.p. > 250,  $[\alpha]_{589} = +39.5$  (c = 0.5, methanol).

25

By crystallization with (-)-O,O'-dibenzoyltartaric acid there was obtained (-)-cis-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with HCl in methanol into the hydrochloride. After  
30 recrystallization from ethanol there was obtained (-)-trans-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one hydrochloride with m.p. > 250°,  $[\alpha]_{589} = -41.2$  (c = 0.5, methanol).

40  
Example 46

(+)-cis-2,7-Dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one

5 (-)-cis-2,7-Dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one

In an analogous manner to that described in Example 43, from cis-2,7-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one by crystallization with (+)-O,O-dibenzoyl-tartaric acid there was obtained (+)-cis-2,7-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with fumaric acid in ethanol into the fumarate. After recrystallization from ethanol there was obtained (+)-cis-2,7-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one fumarate (1:1) with m.p. 230.5-232°,  $[\alpha]_{589} = +6.8$  (c = 0.5, H<sub>2</sub>O).

By crystallization with (-)-O,O-dibenzoyltartaric acid there was obtained (-)-cis-2,7-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with fumaric acid in ethanol into the fumarate. After recrystallization from ethanol there was obtained (-)-cis-2,7-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one fumarate (1:1) with m.p. 230.5-232°,  $[\alpha]_{589} = -5.6$  (c = 0.5, H<sub>2</sub>O).

Example 47

(+)-cis-2,7,9-Trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

(-)-cis-2,7,7-Trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 43, from cis-2,7,9-trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one by crystallization with (+)-O,O'-dibenzoyl-tartaric acid there was obtained (+)-cis-2,7,9-trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was

converted with fumaric acid in ethanol into the fumarate. After  
recrystallization from ethanol there was obtained (+)-cis-  
2,7,9-trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]iso-  
quinolin-6-one fumarate (1:1) with m.p. 219-220°,  $[\alpha]_{589} = +22.8$   
5 (c = 0.5, H<sub>2</sub>O).

By crystallization with (-)-O,O-dibenzoyltartaric acid  
there was obtained (-)-cis-2,7,7-trimethyl-1,3,4,4a,5,10b-  
hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted  
10 with fumaric acid in ethanol into the fumarate. After  
recrystallization from ethanol there was obtained (-)-cis-  
2,7,9-trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
isoquinolin-6-one fumarate (1:1) with m.p. 219-220°,  $[\alpha]_{589} =$   
-22.8 (c = 0.5, H<sub>2</sub>O).

15

#### Example 48

(-)-cis-2-Methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
isoquinolin-6-one  
20 (+)-cis -2-Methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
isoquinolin-6-one

In an analogous manner to that described in Example 43,  
from cis-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-  
25 isoquinolin-6-one by crystallization with (-)-O,O'-di-p-  
toluoyltartaric acid there was obtained (-)-cis-2-methyl-1,3,  
4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was  
converted with fumaric acid in ethanol into the fumarate.  
After recrystallization from ethanol there was obtained (-)-  
30 cis-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]iso-  
quinolin-6-one fumarate (1:1) with m.p. 206.5-208.5°,  $[\alpha]_{589} =$   
-21.6 (c = 0.5, H<sub>2</sub>O).

By crystallization with (+)-O,O'-di-p-toluoyltartaric acid  
35 there was obtained (+)-cis-2-methyl-1,3,4,4a,5,10b-hexa-  
hydro-2H-benzo[h]isoquinolin-6-one, which was converted with  
fumaric acid in ethanol into the fumarate. After recrystal-  
lization from ethanol there was obtained (+)-cis-2-methyl-

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1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one fumarate (1:1) with m.p. 207-209°,  $[\alpha]_{589} = + 20.8$  (c = 0.5, H<sub>2</sub>O).

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**Example 49**

cis-8-Fluoro-2-propyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one

- 10 a) 0.45 g (1.92 mmol) of 8-fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one was dissolved in 6 ml of anhydrous chloroform and added dropwise at room temperature over 15 minutes to a solution of 244 mg (2.3 mmol) of cyanogen bromide in 2 ml of anhydrous chloroform. Subsequently, the mixture was heated under reflux for a further 15 75 minutes, concentrated in a vacuum, taken up with 12 ml of 2N hydrochloric acid and heated under reflux over 6 hours. Subsequently, the mixture was made basic with 3N sodium hydroxide solution and extracted three times with 50 ml of 20 diethyl ether each time. The combined organic phases were washed once with 70 ml of saturated sodium chloride solution, dried (MgSO<sub>4</sub>) and concentrated in a vacuum. 0.29 g (69%) of cis-8-fluoro-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one was obtained as a yellow oil.
- 25 b) A mixture of 0.29 g (1.32 mmol) of cis-8-fluoro-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, 0.12 ml (1.39 mmol) of bromopropane, 0.2 g (1.45 mmol) of potassium carbonate and 20 ml of anhydrous DMF was heated to 125°C for 30 1 hour. Subsequently, the mixture was poured into 3 ml of water and extracted once with 50 ml of ethyl acetate. The organic phase was washed once with 40 ml of saturated sodium chloride solution, dried (MgSO<sub>4</sub>) and concentrated in a vacuum. The crude product obtained was purified by column chromatography on silica gel (methylene chloride/methanol/NH<sub>4</sub>OH 35 9:1:0.2). There were obtained 220 mg (63%) of cis-8-fluoro-2-propyl-1,3,4,4a, 5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one

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as a yellow oil, which was converted with MeOH/HCl into the hydrochloride with m.p. > 220°.

### Example 50

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cis-8-Fluoro-2-ethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one

In an analogous manner to that described in Example 49 b), from cis-8-fluoro-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one by alkylation with ethyl bromide there was obtained cis-8-fluoro-2-ethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with MeOH/HCl into the hydrochloride with m.p. > 220°.

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### Example 51

cis-2-Benzyl-8-fluoro-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one

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In an analogous manner to that described in Example 49 b), from cis-8-fluoro-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one by alkylation with benzyl bromide there was obtained cis-2-benzyl-8-fluoro-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted with MeOH/HCl into the hydrochloride with m.p. > 220°.

25

### Example 52

30 (+)-7,9-Dimethyl-2-propyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one

In an analogous manner to that described in Example 49 b), from (+)-7,9-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one by alkylation with bromopropane there was obtained (+)-7,9-dimethyl-2-propyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one, which was converted

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with fumaric acid into the fumarate<sup>44</sup> (1:1) with m.p. 220.5-226.5°,  $[\alpha]_{589} = +33.7$  (c = 0.5, H<sub>2</sub>O).

The (+)-7,9-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-  
5 benzo[h]isoquinolin-6-one used was prepared as follows:

a 2.1) 0.76 ml (5.65 mmol) of 2,2,2-trichloroethyl chloro-  
formate was added at 100° to a suspension of 500 mg  
(2.26 mmol) of (+)-cis-2,7,9-trimethyl-1,3,4,4a,5,10b-  
10 hexahydro-2H-benzo[h]isoquinolin-6-one and 120 mg of K<sub>2</sub>CO<sub>3</sub>  
in 20 ml of toluene and the mixture was heated at reflux for  
16 hours. Subsequently, the solution was cooled to room  
temperature and poured on to 40 ml of ice-water. The aqueous  
phase was extracted twice with 50 ml of ethyl acetate, dried  
15 (MgSO<sub>4</sub>), filtered and evaporated. Chromatography of the  
residue (silica gel, hexane/ethyl acetate 4:1) yielded 890 mg  
(97%) of 2,2,2-trichloroethyl 7,9-dimethyl-6-oxo-  
3,4,4a,5,6,10b-hexahydro-1H-benzo[h]isoquinoline-2-  
carboxylate as a colourless oil.

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a 2.2) 250 mg of Zn powder were added to a solution of  
890 mg (2.2 mmol) of 2,2,2-trichloroethyl 7,9-dimethyl-6-oxo-  
3,4,4a,5, 6,10b-hexahydro-1H-benzo[h]-isoquinoline-2-  
carboxylate in 10 ml of glacial acetic acid and the mixture was  
25 stirred at room temperature for 16 hrs. The solution was  
filtered and adjusted to pH 10 with 28% NaOH. The aqueous  
phase was extracted twice with the 30 ml of methylene  
chloride, dried (Na<sub>2</sub>SO<sub>4</sub>), filtered and evaporated. Chroma-  
tography of the residue (silica gel, methylene chloride/  
30 methanol/NH<sub>4</sub>OH 200:10:1) yielded 420 mg (83%) of 7,9-  
dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-  
one as a colourless oil.

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Example A

Tablets of the following composition are produced in the usual manner:

	<u>mg/tablet</u>
5 Active ingredient	100
Powd. lactose	95
White corn starch	35
Polyvinylpyrrolidone	8
10 Na carboxymethylstarch	10
Magnesium stearate	<u>2</u>
Tablet weight	250

Example B

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Tablets of the following composition are produced in the usual manner:

	<u>mg/tablet</u>
Active ingredient	200
20 Powd. lactose	100
White corn starch	64
Polyvinylpyrrolidone	12
Na carboxymethylstarch	20
Magnesium stearate	<u>4</u>
25 Tablet weight	400

Example C

Capsules of the following composition are produced:

	<u>mg/capsule</u>
30 Active ingredient	50
Cryst. lactose	60
Microcrystalline cellulose	34
Talc	5
35 Magnesium stearate	<u>1</u>
Capsule fill weight	150

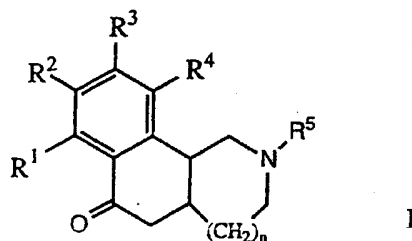
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The active substance having a suitable particle size, the crystalline lactose and the microcrystalline cellulose are homogeneously mixed with one another, sieved and thereafter talc  
5 and magnesium stearate are admixed. The final mixture is filled into hard gelatine capsules of suitable size.



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Claims

1. Compounds of the general formula



wherein

- R<sup>1</sup>-R<sup>4</sup> each independently signify hydrogen, halogen, hydroxy, lower alkyl, lower-alkoxy or phenyl or R<sup>2</sup> and R<sup>3</sup> together represent -O-CH<sub>2</sub>-O-;
- R<sup>5</sup> signifies hydrogen, lower-alkyl or benzyl; and
- n signifies 0 or 1,
- as well as pharmaceutically acceptable acid addition salts of the compounds of formula I, with the exception of racemic 2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinoline-6-one.

2. Compounds of general formula I according to claim 1 wherein R<sup>4</sup> signifies hydrogen, R<sup>5</sup> signifies methyl and n signifies 1.

3. Compounds according to claim 2, wherein R<sup>1</sup> signifies hydrogen, hydroxy, halogen or methyl, R<sup>2</sup> signifies hydrogen or ethyl and R<sup>3</sup> signifies hydrogen, methyl or methoxy.

4. Compounds according to claims 1-3, rac-trans-8-ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one; rac-cis-7-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one; rac-cis-2,9-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one; rac-cis-7-chloro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one;

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rac-cis-7-fluoro-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one;

rac-cis-2,7,9-trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one;

5 (+)-trans-8-ethyl-7-hydroxy-9-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinoline;

(+)-cis-8-methoxy-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one;

10 (+)-cis-2,7-dimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one;

(+)-cis-2,7,9-trimethyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]isoquinolin-6-one and

(+)-cis-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-benzo[h]-isoquinolin-6-one.

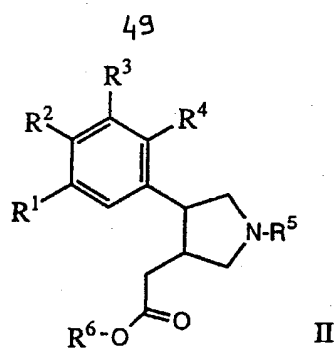
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5. A medicament containing a compound according to any one of claims 1-4 and a therapeutically inert carrier material.

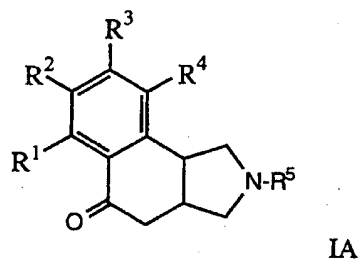
6. A medicament based on a compound I according to  
20 claim 1 and its pharmaceutically acceptable acid addition salts for the treatment or prevention of central nervous disorders such as depressions, bipolar disorders, anxiety states, sleep and sexual disorders, psychoses, schizophrenia, migraine and other  
25 conditions associated with cephalic pain or pain of a different kind, personality disorders or obsessive-compulsive disorders, social phobias or panic states, mental organic disorders, mental disorders in childhood, aggressivity, age-related memory disorders and behavioural disorders, addiction, obesity, bulimia, etc., nervous system damage caused by trauma, stroke, neuro-  
30 degenerative diseases etc.; cardiovascular disorders such as hypertension, thrombosis, stroke etc.; and gastrointestinal disorders such as dysfunction of the gastrointestinal tract motility.

35 7. A process for the manufacture of compounds according to any one of claims 1-4, which process comprises

a) cyclizing a compound of the general formula

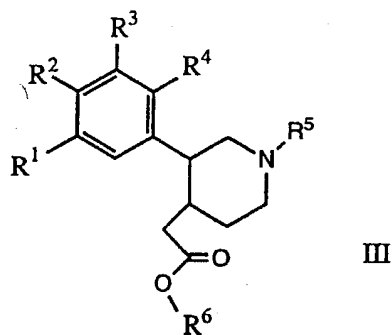


wherein R<sup>6</sup> signifies lower-alkyl,  
 5 to give a compound of the general formula



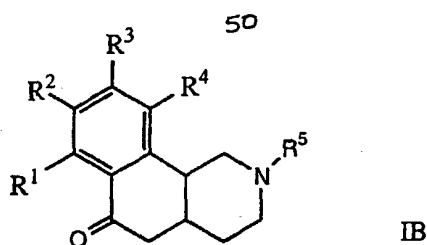
wherein the substituents R<sup>1</sup>-R<sup>5</sup> have the significances set  
 10 forth in claim 1, or

b) cyclizing a compound of the general formula



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to give a compound of the general formula



wherein R<sup>1</sup>-R<sup>5</sup> have the significance set forth in claim 1  
and R<sup>6</sup> has the significance given earlier in this claim,

5

or

c) alkylating or benzylating a compound of general formula I in  
which R<sup>5</sup> signifies hydrogen, or

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d) desalkylating a compound of general formula I in which R<sup>5</sup>  
signifies alkyl or benzyl, or

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e) in a compound of general formula I in which at least one of  
R<sup>1</sup>-R<sup>4</sup> signifies an alkoxy group, converting this/these into (a)  
hydroxy group(s), and

f) if desired, converting the compound of formula I obtained  
into a pharmaceutically acceptable acid addition salt.

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8. Compounds according to any one of claims 1-4, insofar  
as they are manufactured according to the process defined in  
claim 7 or a process equivalent thereto.

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9. Compounds according to any one of claims 1-4, as well  
as pharmaceutically acceptable salts thereof for use as thera-  
peutically active substances.

10. The use of compounds according to any one of  
claims 1-4 and of rac.-2-methyl-1,3,4,4a,5,10b-hexahydro-2H-  
benzo[h]isoquinolin-6-one and of pharmaceutically usable salts  
thereof, especially for the treatment or prevention of central  
nervous disorders such as depressions, bipolar disorders, anxiety  
states, sleep and sexual disorders, psychoses, schizophrenia,

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migraine and other conditions associated with cephalic pain or pain of a different kind, personality disorders or obsessive-compulsive disorders, social phobias or panic states, mental organic disorders, mental disorders in childhood, aggressivity, 5 age-related memory disorders and behavioural disorders, addiction, obesity, bulimia, etc., nervous system damage caused by trauma, stroke, neurodegenerative diseases etc.; cardiovascular disorders such as hypertension, thrombosis, stroke etc.; and gastrointestinal disorders such as dysfunction of the gastro- 10 intestinal tract motility, and, respectively, for the production of corresponding medicaments.

11. The invention as hereinbefore described.

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\* \* \*

# INTERNATIONAL SEARCH REPORT

International Application No <b>PCT/EP 98/00043</b>		
<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC 6 C07D221/10 C07D209/62 A61K31/435 A61K31/40 C07D491/04 //(C07D491/04,317:00,221:00)		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC 6 C07D A61K		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used)		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 19 26 022 A (SANDOZ AG) 4 December 1969 cited in the application see claims and examples 1 and 2 ---	1-3,5,6, 10
A	EP 0 461 353 A (ABBOTT LABORATORIES) 18 December 1991 see claims ---	1-10
A	EP 0 201 085 A (PENNWALT CORPORATION) 12 November 1986 see claims -----	1-10
<input type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search  <b>21 April 1998</b>		Date of mailing of the international search report  <b>28/04/1998</b>
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer  <b>Henry, J</b>

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PCT/EP 98/00043

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